

TRANSPORT PROPERTIES FOR DIFFERENT BUBBLER DESIGNS

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ABSTRACT

In the MOVPE process a steady, controllable flux of precursor into the reaction chamber is a key factor when fabricating highly complex device structures employing ternary and quaternary layers. Historically a simple bubbler design has been employed to perform this task with carrier gas flow and source temperature control able to provide a suitably stable system. However with the increasing volume demands placed on MOVPE equipment increased flows and larger bubblers have become necessary and the simple dip tube approach is no longer 100% suitable.

In this study an investigation of 3 novel bubbler dip leg designs A,B & C (Figures 1 & 2) has been performed and a comparison made with the standard approach D. An Epison III ultrasonic analyser was employed to monitor the pick up of the precursor from a variety of bubblers across a range of flow rates and temperatures. Flows up to 10 sldm have been investigated and differences observed between bubbler dip leg designs. These results highlight the improvements achievable using a new crosspiece dip leg design (Figure 3).

The new sparge system developed was tested for 100mm diameter and above sized bubblers specifically for use with high carrier gas flows. The centrally positioned dip pipe ending in a crosspiece with a number of laterally directed holes provided highly stable output concentrations across a wide range of pick up conditions. Furthermore drop off of pick up rate was delayed to low fill levels (Figures 4 & 5).

An added benefit observed related to bubbler fill levels and the onset of physical carry over of product at high carrier flow rates. It was found that significantly reduced surface agitation could be achieved with the new arrangement allowing up to 80% fill levels to be employed without entrainment effects.

In the particular case of Solution TMITM a further advantage of the cross dipleg arrangement is a constant agitation of the suspended solid TMI to reduce any possibility of settling and packing occurring.

Finally this new type of sparge system will allow access to higher flow rates negating the requirements for parallel sources of the same precursor currently employed to achieve high concentrations entering the reaction chamber itself.

FIGURES

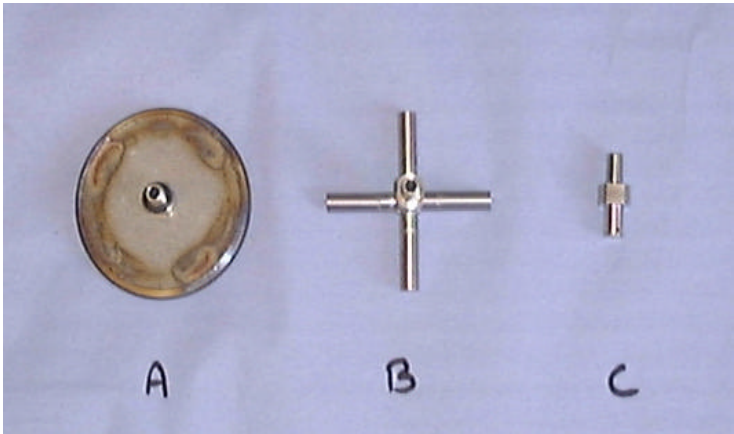


Figure 1. Alternative dip tube attachments

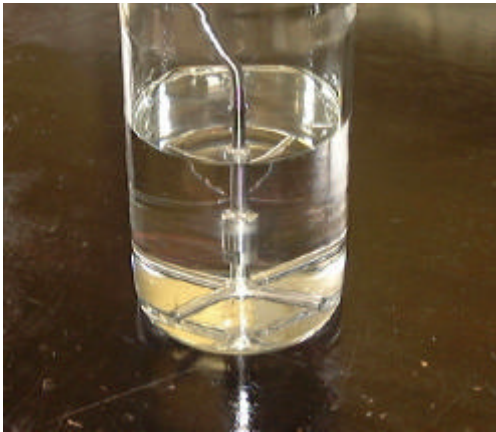


Figure 2. Dip leg B in situ

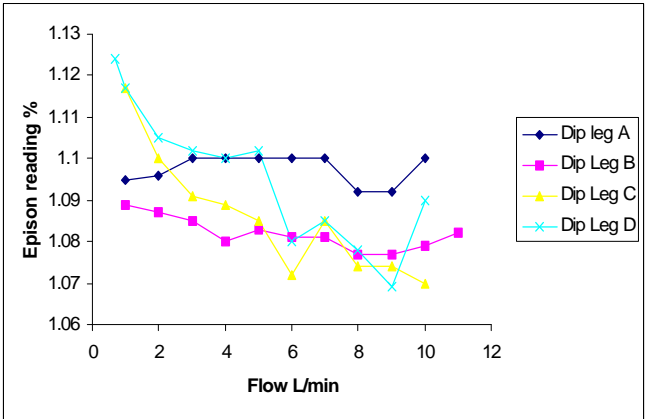


Figure 3. Gas phase concentration measurements for differing dip tube configurations

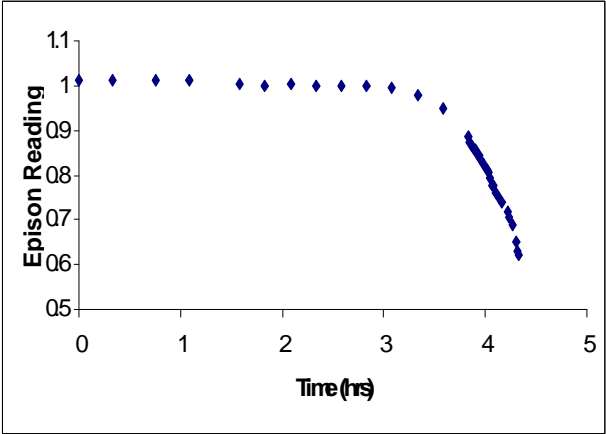


Figure 4. Gas phase concentration measurements at the end of a bubblers lifetime using Dip leg B

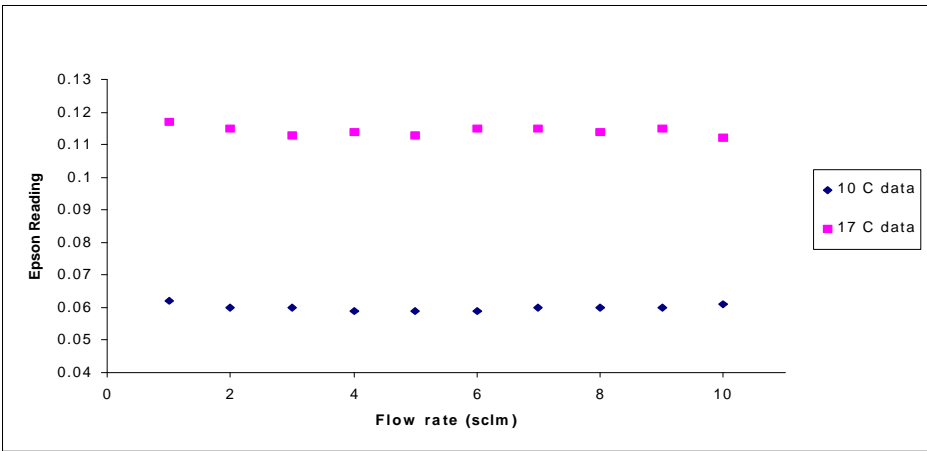


Figure 5. Solution TMI™ bubbler output performance using Dip leg B at 10C and 17C